THE DOMINION RANGE (DOM) LUNAR REGOLITH BRECCIA PAIRING GROUP.

K. Righter[1], J. Schutt[2], C. Satterwhite[3], K. Pando[3], C. Corrigan[4], J. Karner[5], R.P. Harvey[2], C. Calva[3], and R. Harrington[3], [1]Astromaterials Curation, Mailcode XI2, 2101 NASA Parkway, NASA Johnson Space Center, Houston, TX 77058; kevin.righter-1@nasa.gov; [2]Dept. of Earth, Atmospheric and Environmental Sciences, Case Western Reserve University, Cleveland, OH; [3]Jacobs Technology, Mailcode XI2, 2101 NASA Parkway, NASA Johnson Space Center, Houston, TX 77058; [4]Dept. Mineral Sciences, NMNH, Smithsonian Institution, Washington DC; [5]Dept. of Geoscience, University of Utah, Salt Lake City, UT.

Introduction: With the Chang-E missions [1], ANGSA sample analysis [2], and Artemis mission progress [3] as three examples of excitement about lunar science, we want to reaffirm and emphasize the importance of lunar meteorites to our understanding of the Moon. There are over 600 lunar meteorites documented with a total combined mass over 1000 kg, roughly 3x more mass than the Apollo samples [4].

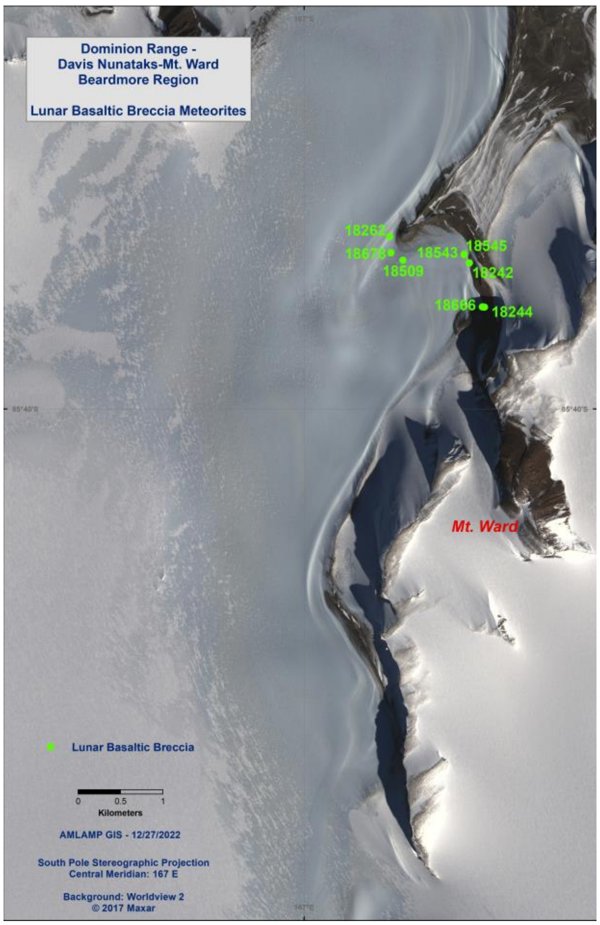

Figure 1: Location of the 8 lunar meteorites from the Dominion Range 2018-19 ANSMET season. *Worldview 2 image – 19 January 2017 (Copyright 2017 Maxar). All Maxar Worldview satellite imagery was acquired through Polar Geospatial Center. Support for this work provided by the Polar Geospatial Center under NSF-OPP awards 1043681 and 1559691.*

The 2018-19 season ANSMET team recovered lunar meteorites, reported in three different newsletters [5-7]. Because these have been announced across three years, 2019-2022, we here provide an overview of their characteristics, reported findings, and comparison to other lunar meteorites. In particular, we emphasize their unique properties and how they may contribute to advancing lunar science.

Table 1: Samples in the DOM lunar pairing group

Sample	mass (g)	log X
DOM 18242	15.92	4.280
DOM 18244	25.07	4.200
DOM 18262	6.78	4.480
DOM 18509	16.52	4.130
DOM 18543	13.59	4.220
DOM 18545	5.46	4.010
DOM 18666	45.87	4.160
DOM 18678	11.64	4.420
Total	140.85	

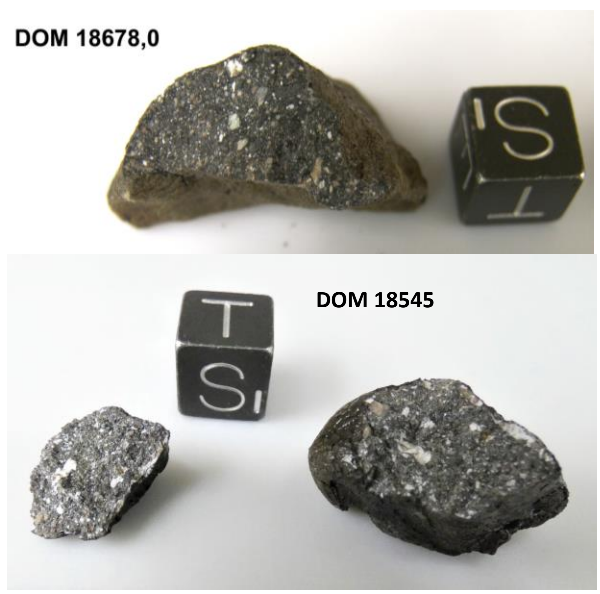

Figure 2: *Macroscopic images of lunar meteorites DOM 18678 and DOM 18545, illustrating the basaltic (dark) and feldspathic (white) clasts as well as the dark matrix.*

Recovery: Eight pieces were recovered in the 2018-19 ANSMET season. All were found near the northern edge of the blue ice tongue or at the edge in the moraine (**Figure 1**). The largest mass is 45.87 g, ranging down to lowest mass of 5.46 g (**Table 1**).

Macroscopic and microscopic characteristics: All of the DOM lunar masses have greyish olive fusion crust, with mostly feldspathic lithic clasts up to 0.5 cm in size. In addition to the feldspathic clasts are basaltic lithic clasts (many pyroxene or pyroxene-rich) of similar size but rarer; they can be seen in some interior images of the meteorites (**Figure 2**). The matrix is coherent and fine grained, dark in color, and comprises most of the mode of the sample.

Magnetic susceptibility: Measurements of magnetic susceptibility were made with an SM30 handheld magnetic susceptibility meter, used routinely at JSC as a non-destructive characterization technique. All 8 have a range from 4.01 to 4.5 (**Figure 3**).

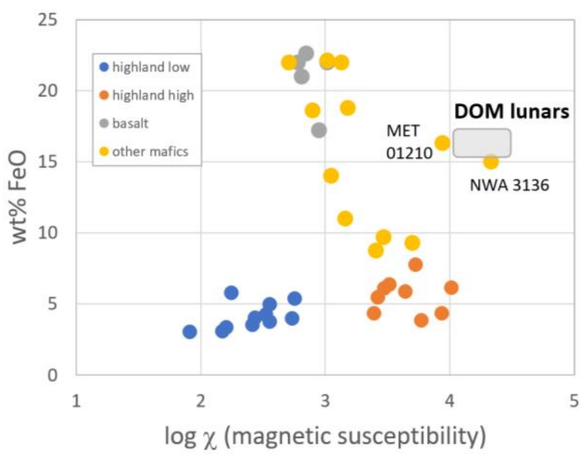

Figure 3: *Magnetic susceptibility (logχ) vs. bulk FeO (wt%) for lunar meteorites. Data from [8] (highland, basalt, and other mafics), and from this study. "DOM lunars" field is based on our magnetic susceptibility measurements combined with bulk FeO content measured on fusion crust reported by [9].*

Scientific findings: Comparison of magnetic susceptibility values for the DOM lunars to other lunar meteorite types shows they are somewhat unique among the lunar meteorites. The values range between 4.01 and 4.48, similar in magnitude to two other lunar meteorites – MET 01210 and NWA 3136 (**Figure 3**).

Studies of the petrology and geochemistry of the DOM lunars has shown they are indeed a mixture of basaltic and feldspathic materials and are polymict breccias [9-12]. Petrologic similarities to the MET 01210 polymict breccia suggest that they could be launch paired [9,15]. This could also be supported given the similarity in bulk composition and magnetic susceptibility (**Figure 3**).

Measurements of volatile elements in apatites from a few of the DOM lunars have allowed a better understanding of their volatile content (H, Cl, F, S) [14,16], and have indicated the possibility of heterogeneous volatile contents of the lunar interior.

Continued studies of this pairing group will undoubtedly lead to improved understanding of regolith processes, lunar petrology, and lunar volatiles.

References: [1] Zhou, C., et al. (2022) *Advances in Space Research* 69.1: 823-836. [2] McCubbin, F. M., et al. (2022) *MaPS 57, abstract*, 85th Annual Meeting of the Meteoritical Society, # 6432. [3] Gross, J., et al. (2022) *MaPS 57, abstract*, 85th Annual Meeting of the Meteoritical Society, # 6310. [4] https://meteorites.wustl.edu/lunar/moon_meteorites_list_alpha.htm. [5] Satterwhite, C. E. and Righter, K. (2019) Ant. Met. Newsl. 42 no. 2. [6] Satterwhite, C. E. and Righter, K. (2020) Ant. Met. Newsl. 43 no. 1. [7] Satterwhite, C. E. and Righter, K. (2022) Ant. Met. Newsl. 45 no. 2. [8] Rochette, P. et al. (2010) Earth Planet. Sci. Lett. 292: 383–391. [9] Gross, J. et al. (2020) 51st Lunar Planet. Sci. Conf., abstract # 2555. [10] McLeod, C. L. et al. (2020) 51st Lunar Planet. Sci. Conf., abstract # 2634. [11] Zeigler, R.A. et al. (2021) 84th Annual Meeting of The Meteoritical Society, abstract #6141. [12] Ireland, S.M. (2021) 52nd Lunar Planet. Sci. Conf., abstract # 2646. [13] Schweitzer, A.R. (2022) 53rd Lunar Planet. Sci. Conf., abstract # 2030. [14] Hayden, T.S. (2021) 52nd Lunar Planet. Sci. Conf., abstract # 1550. [15] Hayden, T.S. (2022a) 53rd Lunar Planet. Sci. Conf., abstract # 1886. [16] Hayden, T.S. (2022b) 53rd Lunar Planet. Sci. Conf., abstract # 1894.